

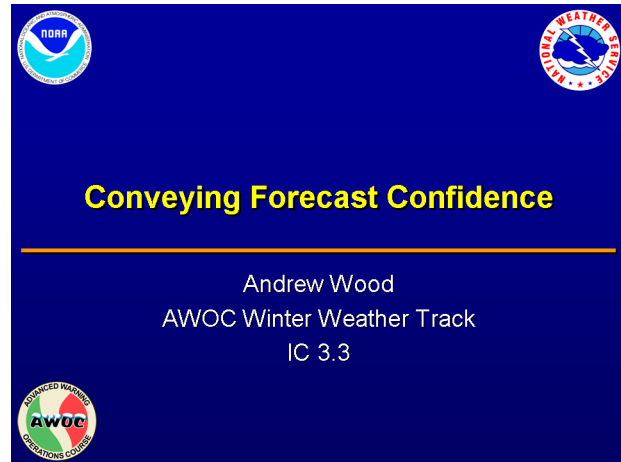
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## 1. IC3.3: Conveying Forecast Confidence

**Instructor Notes:** Welcome to the AWOC Winter Track Instructional Component 3, Lesson 3. This presentation, entitled Conveying Forecast Confidence, should last approximately 15 minutes.

**Student Notes:**



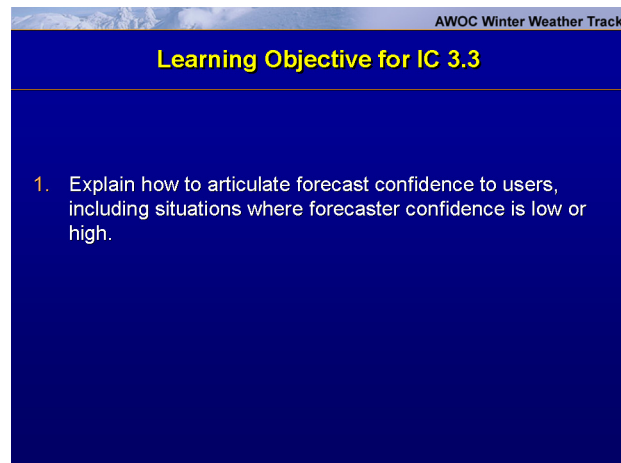
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## 2. Learning Objective for IC 3, Lesson 3

**Instructor Notes:** There is one learning objective with this lesson. By the end of this lesson, you should be able to explain how to articulate forecast confidence to users, including situations where forecaster confidence is low or high.

**Student Notes:**



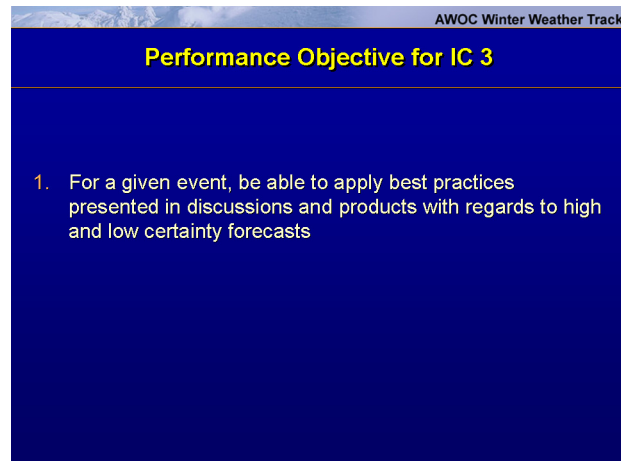
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## 3. Performance Objective for IC 3

**Instructor Notes:** There is also one performance objective with this lesson. For a given event, you should be able to apply the best practices presented in discussions and products with regards to high and low certainty forecasts.

**Student Notes:**



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### Performance Objective for IC 3

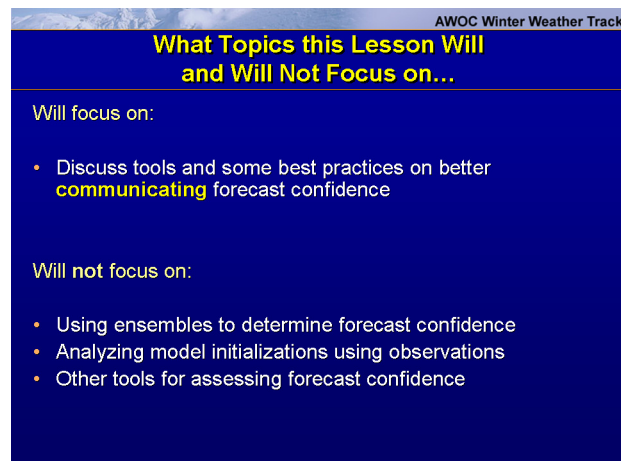
1. For a given event, be able to apply best practices presented in discussions and products with regards to high and low certainty forecasts

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## 4. What Topics this Lesson Will and Will Not Focus on...

**Instructor Notes:** It's important, for starters, to note what topics this lesson will and will not cover. This lesson will discuss some ways to better communicate forecast confidence to users once that confidence has been determined. This lesson will not go into detail on using ensembles to determine forecast confidence. That will be covered in IC 6, Lesson 3. Nor will it discuss in detail analyzing model initializations using observations or other tools for assessing forecast confidence.

**Student Notes:**



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### What Topics this Lesson Will and Will Not Focus on...

Will focus on:

- Discuss tools and some best practices on better **communicating** forecast confidence

Will **not** focus on:

- Using ensembles to determine forecast confidence
- Analyzing model initializations using observations
- Other tools for assessing forecast confidence

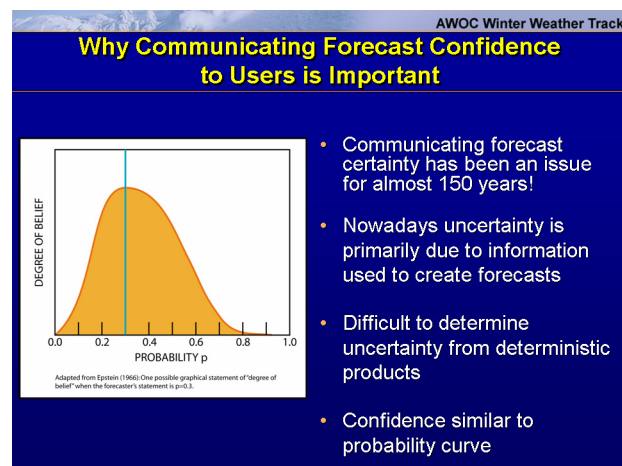
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## 5. Why Communicating Forecast Confidence to Users is Important

**Instructor Notes:** Conveying forecast confidence is a critical part of winter weather forecasting. In many parts of the US, winter precipitation is a common occurrence during the cold season. Back in Lesson 1, we discussed how even light events can be significant in the right context. Users across the board need some guidance as to how confi-

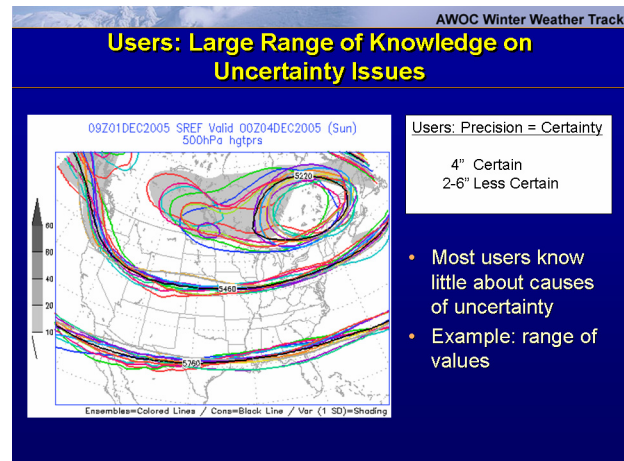
dent, or certain, NWS meteorologists are in the forecasts and products they issue. This issue is not a new one, as it's been around since the first U.S. weather observers issued forecasts almost 150 years ago. The primary difference between now and then is that, for much of that time, uncertainties were largely in the knowledge base of the forecaster about the atmosphere. Nowadays, the uncertainties are more in the knowledge or information base a forecaster uses (such as NWP) to create a forecast (Murphy, 1998). By their nature, many NWS products and services are deterministic. In contrast, forecaster certainty, or degree of belief in a forecast, can best be thought of as a probability curve. Such a curve would be tall with a sharp drop off for high certainty forecasts and flatter and wider for lower confidence forecasts. Conveying that mental curve to users helps distinguish “what’s likely” from “what’s possible”. Whether we like it or not, our users have a mental degree of belief in our forecasts based upon their past experiences (Epstein, 1966).

### Student Notes:



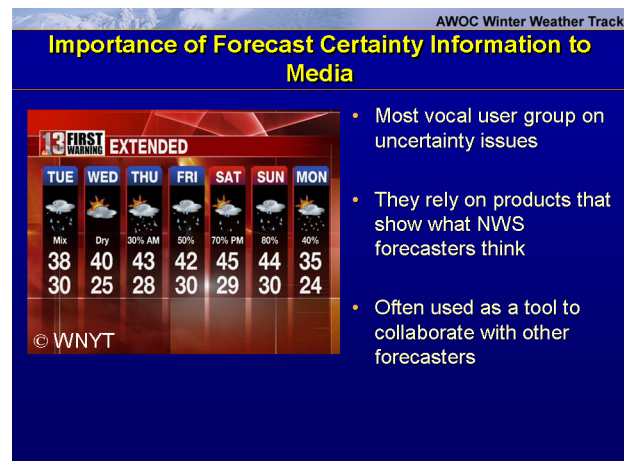
## 6. Users: Large Range of Knowledge on Uncertainty Issues

**Instructor Notes:** Not much of the general public are knowledgeable users of meteorological products. Most people lack an understanding about the causes of forecast uncertainty. This lack of knowledge is due mostly to users unfamiliarity with the forecast process itself. While we may not believe it, many users think a forecaster must be fairly certain if they are providing exact information. For instance, a forecast that states city A will get about 2” of snow will be considered more certain than a forecast of 1-3”. Both forecasts could be from the same person, but the difference in perceived certainty will be based on the exactness of the forecast. Fortunately for us, forecasts are standard enough that users usually don’t see large variations in forecast totals from forecaster to forecaster. This example does remind us that our users may see our forecast differently than we do because they are not involved in the process. This difference in perception is especially true for forecast certainty issues.

**Student Notes:**

## 7. Importance of Forecast Certainty Information to Media

**Instructor Notes:** Our more regular users, especially the media, have a much better handle on this issue. Of all the user groups, they may be the most vocal about forecast certainty issues. In the NWS User Surveys of the Media (NWS, 2003), a recurring theme was the importance that local media placed on products (such as Short Term Forecasts, Area Forecast Discussions, etc.) that can provide a view into the thinking of the NWS forecaster. Since many media-based forecasters often work by themselves, these products are often how they collaborate with other forecasters. They can compare their own thinking to these products and get a better understanding of the reasoning used in their own forecasts.

**Student Notes:**

## 8. Tools for Conveying Forecast Confidence to Users: Text Products

**Instructor Notes:** Since most text products are deterministic in nature, quantifying and communicating uncertainty to our users in those products can be a big challenge. That's why AFDs, as a generally free-format, narrative product, are so important. It is one of the best ways for forecasters to express what they are thinking with regard to their forecast and why (NWS ERS, 2004). NWS Surveys from the past few years indicate that more users are relying on AFDs for this information than in the past. There is no reason to think this trend will stop anytime soon. Because of their nature, AFDs show a local, even personal, flavor. As a result, trying to provide individual, detailed guidance on better using AFDs to convey forecast certainty would be futile in this type of training delivery. That kind of assistance, if needed, really has to come from within the WFO. That being said, there are some general (or big picture) good practices that can be passed along. For starters, more regular users often access AFDs on-line now. As a result, there are some trends in how AFDs are being displayed (and will be displayed in the future). Such features as links to previous versions of AFDs are common practice now. Some forecast offices have also started adding URL links to the body of their AFDs that appear on-line. These links go to other products as well as to a glossary of technical terms and abbreviations. Using links in this way is a powerful tool to both help inexperienced users of AFDs as well as all users who want to quickly move from product to product. While not occurring operationally yet, it will only be a matter of time when AFDs, as well as other products, are converted from "ALL CAPS" to standard text for web usage. Such a change, when it occurs, will be very welcome to users who often commented on the readability issues of "ALL CAPS" (NWS, 2005).

### Student Notes:

- AFDs primary for expressing uncertainty
- Local, personal flavor of AFDs requires similar local guidance
- AFDs in the Internet age

## 9. Interactive Quiz #1

**Instructor Notes:** Take a moment to complete this interactive quiz.

### Student Notes:

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## 10. Importance of Clarity in Conveying Forecast Confidence

**Instructor Notes:** Making AFDs more accessible has also made them more visible. This higher visibility can tempt people to simplify the content of AFDs. NWS surveys and utilization research strongly suggest that it is clarity, not simplicity, that users want in AFDs. The following are some general comments on how AFDs can be made clearer, which will help better convey certainty. For instance, a crucial element to clear writing is to try and write as naturally as possible, no matter what that style is. Another important way to improve clarity is to minimize or eliminate abbreviations in AFDs. Some forecasters have been using abbreviations so long that they probably don't realize how often they use them. It has, in fact, become natural to them. The problem with abbreviations is that they can be overused and they make AFDs much less readable. Occasional abbreviations where the context of their usage makes their meaning obvious are certainly acceptable. What you don't want, from a users standpoint, is to have a product that looks like you abbreviated every other word. Another good practice to develop is simple organization and revision. There are many basic organizational techniques that can be used to boost readability, such as breaking out key information into separate blocks of text, using headlines to highlight key information, or even just making each period or forecast issue of the discussion a separate paragraph. Don't forget to spend some time revising the discussion, too. Consider having another forecaster on shift with you read the discussion or try to read your own writing as a user might. Most important is to catch obvious typos, repetitions, etc., that can have a negative impact on users.

### Student Notes:

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### Importance of Clarity in Conveying Forecast Confidence



MEANWHILE...ASSOC CD FNT WL  
CONT SVR WX THREAT ACRS ERN  
CONUS TDY. THIS LW TROF WL  
INFLUENCE OUR WX INTO THE WKND  
WITH REINFORCING S/W TRVLG  
WITHIN CYCLONIC FLOW  
TOWARD/INTO EA.

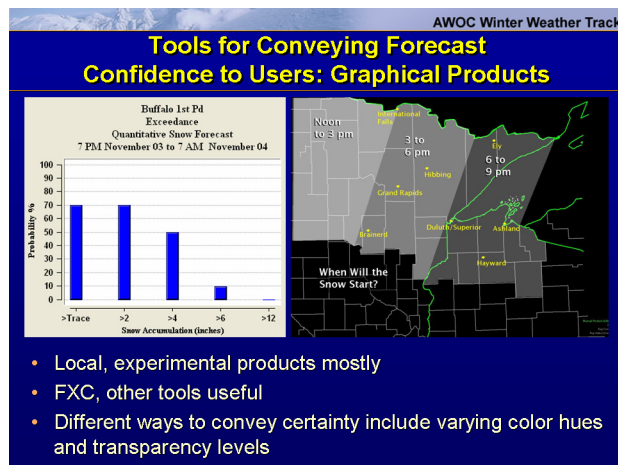
- Clarity, not simplicity, is important
- Write naturally
- Minimize abbreviations
- Organization and Revision



## 11. Tools for Conveying Forecast Confidence to Users: Graphical Products

**Instructor Notes:** AFDs are not the only tool available to forecasters to clarify uncertainty. Many WFOs have developed local graphical products, some of which are experimental, to try to communicate forecast threat information to users. Some of the more common ones for winter weather forecasting involve visualizations of probabilistic snow-fall totals. Others utilize applications like FXNET so that D2D-like displays with simple annotations can be generated quickly with minimal effort on a forecaster's part. Just about any visualization tool can be useful to generate bar charts or other products if that graphic conveys certainty (or uncertainty) in forecast details. The National Academy of Sciences workshop (2003) on communicating uncertainties in weather information encouraged the development of graphical products to convey threat information to the public. Not all graphical products are a "home run", so to speak. "Spaghetti" charts and similar ensemble-type displays can help visually represent the range of values to an expert, but may intimidate the average user and be difficult to interpret. Maps similar to SPC convective outlooks (with low, middle, and high classifications) are more user friendly, but forecasters may be hesitant to label something "low confidence." An effective way to communicate uncertainty can be to display a variable using different color hues or levels of transparency to display probabilities (such as graphics that use filled contours to illustrate ensemble "spread"). Such continuous value displays are more inviting to users and can convey significant details to them.

**Student Notes:**



## 12. AFDs: Examples of Effectively Stated Forecast Certainty

**Instructor Notes:** Forecast certainty issues can be addressed in many ways. Some offices may use language that explicitly states "high confidence" or "low confidence", etc. Others may use different language to convey confidence. Regardless of what system your office uses, what is most important is to clearly state what the key issues are with

the forecast and your expert analysis on those issues. The goal should be for users, especially regular users, to correctly interpret your products. In these examples, you see language that state forecast confidence explicitly and implicitly, as well as discussing how forecast certainty is trending. The last text box is a little different than the others. It presents an example where there is mixed certainty. These situations are not only challenging to forecast, but can also be challenging to communicate. If customer utilization of our forecasts and products is one of our ultimate goals, then it's only natural that we may be apprehensive at times to admit to forecast uncertainty. But these cases are when clarity is most crucial. When you are finished reviewing the text, please push the play button to advance to the next slide.

### Student Notes:

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### AFDs: Examples of Effectively Stated Forecast Certainty

FORECAST CONFIDENCE INCREASING FOR POTENTIAL ICING EVENT ACROSS NORTHERN SECTIONS OF STATE LATE TONIGHT THROUGH WED MORNING.

QUITE A FEW FACTORS IN TODAY/S MODELS AND WITH THE CURRENT ATMOSPHERIC TRENDS ARE FAVORING AN ICE STORM AND WILL UPGRADE ALL WATCHES TO ICE STORM WARNINGS WITH THIS PACKAGE

THIS IS ONE OF THE FEW WINTER SYSTEMS WHERE CONTROVERSY IN PRECIPITATION TYPE DOES NOT EXIST. ALL FORECAST ANALYSIS SUGGEST THAT ONLY SNOW WILL BE POSSIBLE.

MODELS IN VERY GOOD AGREEMENT WITH MAIN FEATURES OF NOR'EASTER MOVING UP THE COAST.

THIS SYSTEM HAS A LOT THAT IS FAVORABLE FOR SIGNIFICANT SNOW. HENCE, FEEL VERY CONFIDENT THAT MEASURABLE SNOWS WILL OCCUR. HOWEVER, CHANGES IN EXPECTED TRACK COULD HAVE SIGNIFICANT EFFECTS ON AMOUNTS. GIVEN THIS UNCERTAINTY...

## 13. Examples of Value-Added Text Clarifying Event Impacts and Forecast Certainty Issues

**Instructor Notes:** There will always be a bit of conflict between saying more is more (say, adding a sentence to further illustrate your thinking) and less is more (being concise so that your thought process is clearer). When considering using value-added wording in discussions and other products, be specific and concise. Also, make sure the text, in fact, adds the desired value. You want the additional text to be informative, but not seem like a tangent. These examples add value by discussing details of forecast techniques, event impacts, model diagnosis, conceptual models, and even where to get important information on road conditions. When you are finished reviewing the text, please push the play button to advance to the next slide.



**Student Notes:**

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### Examples of Value-Added Text Clarifying Event Impacts and Forecast Certainty Issues

SOUNDINGS LOOK MORE FAVORABLE FOR FRZG DRIZZLE THAN SNOW WITH THE MOIST LAYER GENERALLY WARMER THAN -10 DEG C.

ONE THING I STRESSED DURING THE CALLS IS THAT EVEN THOUGH THE AIR MAY GO TO 34 THE ROADS WILL LIKELY STAY BELOW FREEZING SEVERAL HOURS LONGER DUE TO PAVEMENT THAT HAS BEEN WELL SUBFREEZING FOR SOME TIME.

BONE DRY ATMOSPHERE IN THE LOWEST LEVELS ARE PROGGED TO SATURATE FROM THE TOP DOWN WHICH THE MODELS TYPICALLY ARE TOO QUICK/AGGRESSIVE DOING.

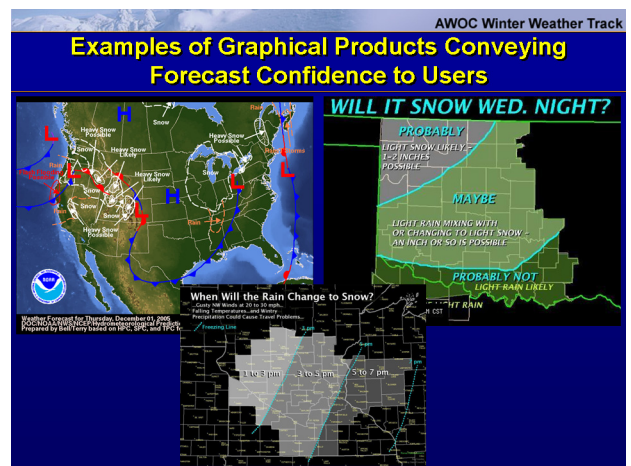
AS ITS TAKEN ON A BIT OF AN ANA FRONT APPEARANCE (FRONT LINED UP WITH UPPER LEVEL WINDS WHICH KEEP ASCENT GOING WELL BEHIND THE BOUNDARY).

ROAD CONDITIONS MAY BE ASSESSED AT THE FOLLOWING NUMBERS...

TEXAS 1.800.452.9292  
NEW MEXICO 1.800.432.4269

## 14. Examples of Graphical Products Conveying Forecast Confidence to Users

**Instructor Notes:** Graphical examples of conveying forecast certainty can be found all over. The “Today’s National Forecast” graphic is an example that most people probably don’t think about, but is really good at conveying levels of certainty among other things. Different types of lines and fills are used to indicate intensity differences, text captions indicate variations in likelihood, and color is even used to differentiate between different precipitation types and threats. The graphic in the upper right is a more obvious example of communicating forecast certainty by highlighting areas where snow chances are likely, possible, and not likely. As stated previously, exactness conveys a higher level of confidence than a range of values. The bottom graphic uses approximate times that are exact for the passage of the sub-freezing air through the CWA. This graphic also does an excellent job at using color fills to distinguish between regions of the map and color coding of text to help users clearly identify what the answer to the question is based upon what region of the CWA they live in.

**Student Notes:**

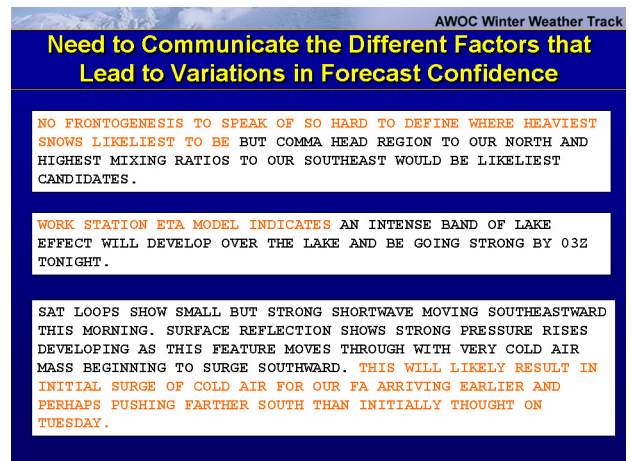
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## 15. Need to Communicate the Different Factors that Lead to Variations in Forecast Confidence

**Instructor Notes:** Some phenomena result in greater forecast uncertainty than others. It can, at times, be beneficial to discuss details of conceptual models that may seem basic to you, but may help users better understand why a particular situation is inherently more uncertain than most cases. Most issues that have significant impacts on forecast confidence are well-known to forecasters. The vast majority of thorough AFDs are more than sufficient at communicating most basic guidance issues to users. What can be helpful is to discuss more details of any experimental or local models, products, etc., that you utilize as clearly as possible. If such a product is available on-line to the public, consider explicitly telling them where it is available so that they can see exactly what you are talking about. Similarly with initialization issues, consider explicitly mentioning your reasoning for suspecting an initialization issue, including going into some details. When you are finished reviewing the text, please push the play button to advance to the next slide.

**Student Notes:**



AWOC Winter Weather Track

### Need to Communicate the Different Factors that Lead to Variations in Forecast Confidence

NO FRONTOGENESIS TO SPEAK OF SO HARD TO DEFINE WHERE HEAVIEST SNOWS LIKELIEST TO BE BUT COMMA HEAD REGION TO OUR NORTH AND HIGHEST MIXING RATIOS TO OUR SOUTHEAST WOULD BE LIKELIEST CANDIDATES.

WORK STATION ETA MODEL INDICATES AN INTENSE BAND OF LAKE EFFECT WILL DEVELOP OVER THE LAKE AND BE GOING STRONG BY 03Z TONIGHT.

SAT LOOPS SHOW SMALL BUT STRONG SHORTWAVE MOVING SOUTHEASTWARD THIS MORNING. SURFACE REFLECTION SHOWS STRONG PRESSURE RISES DEVELOPING AS THIS FEATURE MOVES THROUGH WITH VERY COLD AIR MASS BEGINNING TO SURGE SOUTHWARD. THIS WILL LIKELY RESULT IN INITIAL SURGE OF COLD AIR FOR OUR FA ARRIVING EARLIER AND PERHAPS PUSHING FARTHER SOUTH THAN INITIALLY THOUGHT ON TUESDAY.

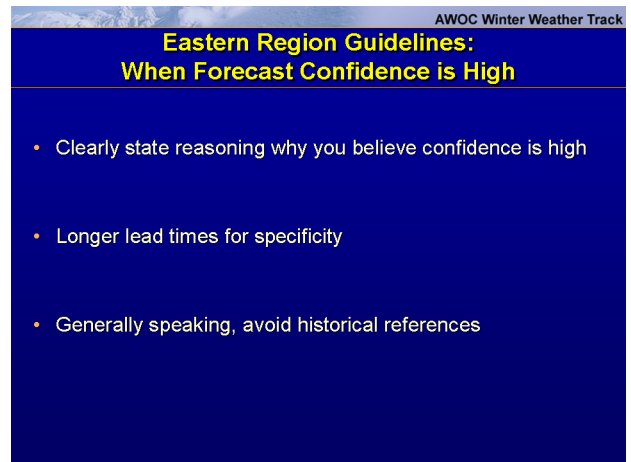
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## 16. Eastern Region Guidelines: When Forecast Confidence is High

**Instructor Notes:** A couple of years ago, an Eastern Region (ER) team of forecasters put together some best practices with regards to winter weather forecasting, including guidelines for situations when forecast confidence is high. In general, forecast confidence is high when model errors build slowly with time and there is good consistency between different models, separate runs of the same model, and/or different members of an ensemble forecast. Other high forecast confidence signs will be model initialization fitting well with observations and model forecasts supported by either forecaster's conceptual model of similar events or with climatology. If you have a high degree of confidence in a forecast of a winter weather event, make sure it's clear in your discussions and other products, when pertinent. These situations allow for increasing the lead times for using language with high levels of specificity. A common issue that can arise with an upcoming,

significant event is the desire to put the forecast into context. After all, it's important, from a utilization standpoint, for events to be put into context. One way to do this is to make reference to historical storms. Generally, such references should be avoided unless confidence is high that a similar event to the historical one is very likely to occur. This advice is certainly not new, but important. Using historical references may be interpreted by users that the upcoming event will be just like the historical one, even if you are trying to make a completely different point.

**Student Notes:**A blue rectangular box with a white border. At the top right, it says "AWOC Winter Weather Track". Below that, in yellow text, is "Eastern Region Guidelines: When Forecast Confidence is High". Below this, there is a bulleted list of three items: "Clearly state reasoning why you believe confidence is high", "Longer lead times for specificity", and "Generally speaking, avoid historical references".

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**Eastern Region Guidelines:  
When Forecast Confidence is High**

- Clearly state reasoning why you believe confidence is high
- Longer lead times for specificity
- Generally speaking, avoid historical references

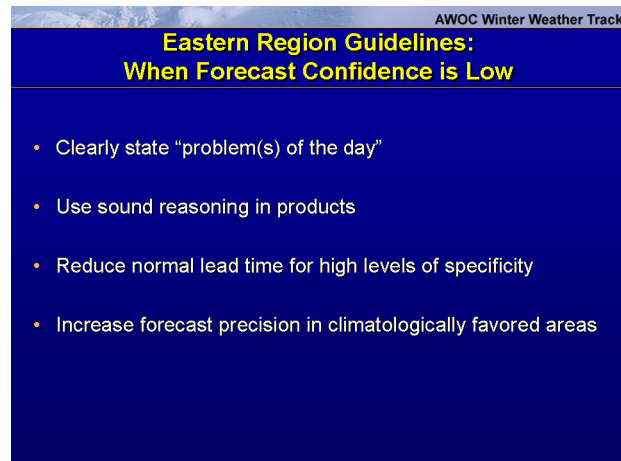
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## 17. Eastern Region Guidelines: When Forecast Confidence is Low

**Instructor Notes:** Similarly, these ER guidelines also include tips for when forecast confidence is low. In general, forecast confidence is low when model errors build rapidly with time and there is a lack of consistency between different models, separate runs of the same model, and/or different members of an ensemble forecast. There may be other issues, such as model initialization problems or the possibility of a “rare” event, that lead to lower confidence. In such events, it is helpful from the user’s standpoint, to clearly state what the “problem(s) of the day” are. Use sound reasoning and lay out the situation in a clear and concise manner so that users understand what ambiguities exist and why. Such a situation calls for using less specific language in warning and advisory products. If only some aspects of a forecast have low certainty, then try to be precise in those aspects of the forecast where confidence is higher. Examples would be in a climatologically favored area or if event timing is fairly certain. Then you can expand specificity in other areas over time as forecast confidence increases.

**Student Notes:**



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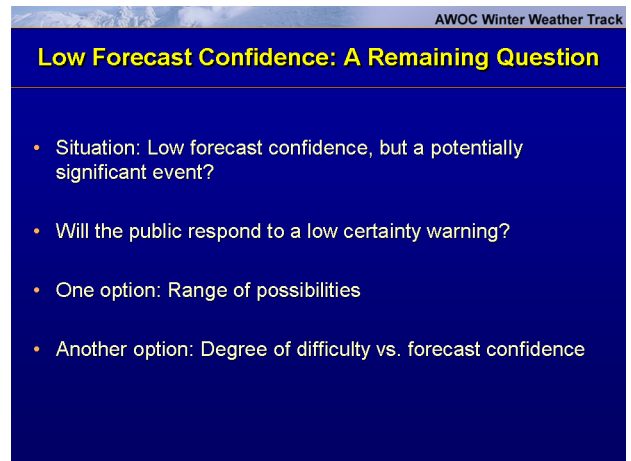
**Eastern Region Guidelines:  
When Forecast Confidence is Low**

- Clearly state "problem(s) of the day"
- Use sound reasoning in products
- Reduce normal lead time for high levels of specificity
- Increase forecast precision in climatologically favored areas

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## 18. Low Forecast Confidence: A Remaining Question

**Instructor Notes:** When it comes to low confidence forecasts, there is one remaining question to be answered and it is a challenging one. Say that there is an impending event that, based on several different meteorological factors, could be very significant for your CWA, but is legitimately a low confidence forecast. If you want to use explicit language to communicate forecaster certainty, and you believe the most likely forecast is a significant event, do you issue a low forecast confidence for, say, a foot of snow? If you do, will your users act upon your warnings? Depending on your personality, situations like this one could keep you up at night! One way to address such a situation is to present a range of possibilities. This approach, when communicated clearly and effectively, can be beneficial at clarifying the threats to our users. The danger in such an approach is that, if not communicated effectively, you can wind up confusing users so that they either read into our products what they want to, or worse, they don't understand what the real threats are. Another way to address it may be by changing the framework by which we state forecast certainty. Instead of stating forecast confidence or certainty, maybe forecasts should be thought of in terms of degrees of difficulty (Craven, 2006). In doing so, a "high" degree of difficulty would be equivalent to a "low" forecast confidence, and vice versa. Such a classification would allow the meteorologist to maintain scientific integrity without appearing clueless. Research is underway (Craven, 2005) to see if such a system would be a more effective way to communicate all levels of forecast uncertainty to regular users. These are certainly not the only ways to address this issue, either.

**Student Notes:**

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### Low Forecast Confidence: A Remaining Question

- Situation: Low forecast confidence, but a potentially significant event?
- Will the public respond to a low certainty warning?
- One option: Range of possibilities
- Another option: Degree of difficulty vs. forecast confidence

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## 19. Learning Interaction #2

**Instructor Notes:** Take a moment to complete this interactive quiz.

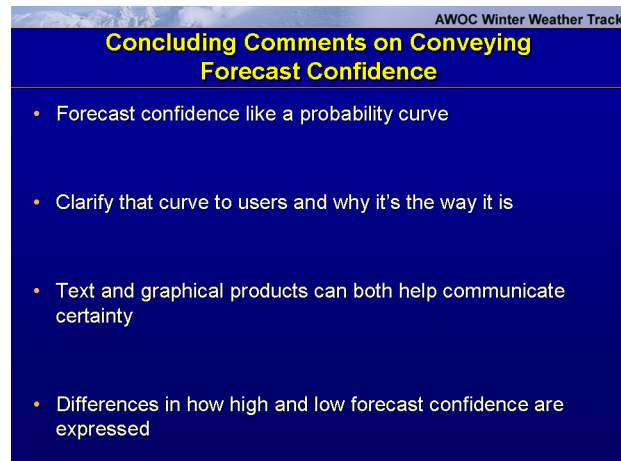
**Student Notes:**

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## 20. Concluding Comments on Conveying Forecast Confidence

**Instructor Notes:** Although many of our products are deterministic in nature, it is important to be able to convey some indication of forecast confidence in products. When thinking of forecast confidence, it helps to think of it as a probability curve. The taller and thinner the curve, the higher the forecast confidence. The flatter and wider the curve, the lower the forecast confidence. When creating text and graphical products for users, you are trying to describe that “curve” to them. The products need to clarify that curve to users and explain why it looks the way it does. Some simple, general tips were included in this lesson that might help with that clarification for both text and graphical products. Lastly, some guidelines produced by experts in Eastern Region on conveying high and low degrees of forecast confidence were presented.

**Student Notes:**



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### Concluding Comments on Conveying Forecast Confidence


- Forecast confidence like a probability curve
- Clarify that curve to users and why it's the way it is
- Text and graphical products can both help communicate certainty
- Differences in how high and low forecast confidence are expressed

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## 21. References

**Instructor Notes:** This slide contains a list of all the references cited in the slides, mentioned by the speaker, or placed in the speaker notes. The full references are listed at the end of the student handouts for IC 3, Lesson 3.

**Student Notes:**



AWOC Winter Weather Track

### References

- Craven, 2005
- Craven, 2006
- Epstein, 1966
- Murphy, 1998
- NAS, 2003
- NWS, 2003
- NWS ERS, 2004
- NWS, 2005

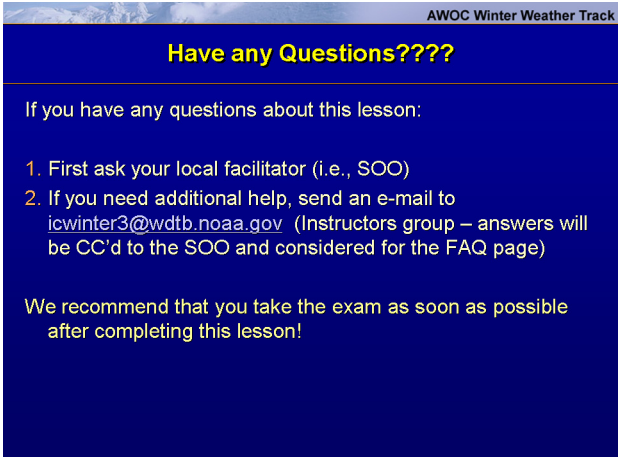
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## 22. Have any Questions????

**Instructor Notes:** If you have any questions about this lesson, first ask your local AWOC facilitator. If you need additional help, send an E-mail to the address provided. When we answer, we will CC your local facilitator and may consider your question for our FAQ page. We strongly recommend that you take the exam as soon as possible after completing this lesson.



**Student Notes:**



AWOC Winter Weather Track

**Have any Questions????**

If you have any questions about this lesson:

1. First ask your local facilitator (i.e., SOO)
2. If you need additional help, send an e-mail to [icwinter3@wdtb.noaa.gov](mailto:icwinter3@wdtb.noaa.gov) (Instructors group – answers will be CC'd to the SOO and considered for the FAQ page)

We recommend that you take the exam as soon as possible after completing this lesson!

